MIL-6-19500/110C 11 April 1972 SUPERSEDING MIL-6-19500/110B 8 November 1965

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, LOW-POWER TYPES 2N328A AND 2N329A

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

- 1. SCOPE
- 1.1 Scope. This specification covers the detail requirements for a PNP, silicon, low-power transistor.
 - 1.2 Physical dimensions. See figure 1 (TO-5).
 - 1.3 Maximum ratings.

PT 1/	VCBO	VEBO	VCEO	Tstg and Top
mW	Vdc	<u>Vdc</u>	<u>Vdc</u>	<u>•c</u>
400	-50	-30	-40 (2N328A) -35 (2N329A)	-65 to +200

1/ Derate linearly 2.28 mW/°C for $T_A > 25$ °C.

1.4 Primary electrical characteristics.

	ΔF	E	VCE	(sat)	VBE	(sat)	fhfb		
Limits	$V_{CE} = -0.5 \text{ Vdc}$ $I_{C} = -3 \text{ mAdc}$		IC = -10 mAdc IB = -2 mAdc	Ic = -15 mAde IB = -2 mAde	IC = -3 mAdc IB = -1 mAdc		V _{CB} = 3	-5 Vdc mAdc	
	2N328A	2N329A	2N328A	2N329A	2N328A	2N329A	2N328A	2N329A	
			Vdc	<u>Vdc</u>	Vdc	<u>Vác</u>	kHz	rH2	
Min Max	18 44	36 88	-0.3	-0.4	-1	-1	200	250	

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2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATION

MILITARY

MTL-6-19500 - Semiconductor Devices, General Specification for.

STANDARDS

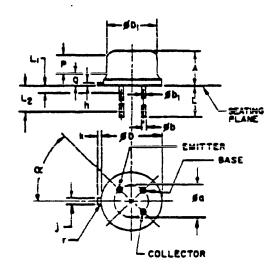
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MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-750 - Test Methods for Semiconductor Devices.

(Copies of specification, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

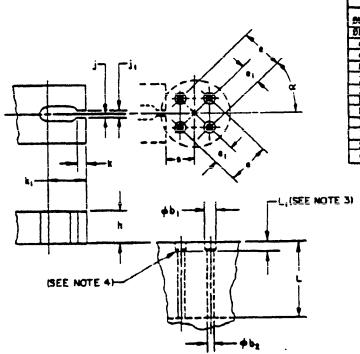
- 3.1 General. Requirements shall be in accordance with MIL-6-19500, and as specified herein.
- 3.2 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in Mil.-S-19500.
- 3.3 Design, construction, and physical dimensions. Transistors shall be of the design, construction, and physical dimensions shown on figure 1.
- 3.3.1 Lead material and finish. Lead material shall be Kovar or alloy 52. Lead finish shall be gold-plated. (Leads may be tin-coated if specified in the contract or order, and this requirement shall not be construed as adversely affecting the qualified-product status of the device, or applicable JAN marking (see 6.2)).
- * 3.3.1.1 Selectivity of lead material. Where choice of lead material (see 3.3.1 above) is desired, it shall be specified in the contract or order (see 6.2).
- 3.4 Performance characteristics. Performance characteristics shall be as specified in tables I, II. and III.
- 3.5 <u>Marking</u>. The following marking specified in MIL-S-19500 may be omitted from the body of the transistor at the option of the manufacturer:
 - (a) Country of origin.
 - (b) Mamufacturer's identification.



DIMENSIONS								
	INC	HES	MILLIM	MILLIMETERS				
LTR	MIN	MAX	MIN	MAX	07-8-5			
A	. 240	. 260	6. 10	6.60				
Ø2	. 200	TP	5.0	8 TP	6			
Øb	. 016	. 021	. 41	, 53	7, 8			
Øb1	.016	. 019	. 41	. 48	7, 8			
ØD	. 335	. 370	8.51	9.40				
ØDi	. 305	. 335	7. 75	8.51				
h	. 009	. 041	. 23	1.04				
)	. 028	. 034	. 71	. 86	2			
Ķ	. 029	. 045	. 74	1,14	3			
L	1.500	1.750	38.10	44. 45	7, 8			
Li		. 050		1.27	7, 8			
L2	. 250		6.35		7, 8			
P	. 100		2,54		5			
Q		. 050		1.27	4			
r		. 010		. 25	10			
B	45	A.L.	45	TP	6			

NOTES

- Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.
- 2. Beyond r(radius) maximum, j shall be held for a minimum length of .011(.28 mm).
- 3. k measured from maximum \$D.
- 4. Outline in this zone is not controlled.
- 5D₁ shall not vary more than .010(.25 mm) in zone P. This zone is controlled for automatic handling.
- 6. Leads at gage plane . 054 + .001-.000(1.37+.03-.00 mm) below seating plane shall be within .007(.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC. The device may be measured by direct methods or by the gage and gaging procedure shown in figure 2.
- 7. \emptyset by applies between L_1 and L_2 . \emptyset b applies between L_2 and L minimum. Diameter is uncontrolled in L_1 and beyond L minimum.
- 8. All three leads.
- 9. All leads electrically insulated from the case.
- 10. r(radius) applies to both inside corners of tab.
 - * FIGURE 1. Physical dimensions of transistor types 2N328A and 2N329A (TO-5).



DIMENSIONS								
	INC	HES	MILLIM	MILLIMETERS				
LTR	MIN	MAX	MIN	MAX	£			
201	. 0595	. 0605	1. 51	1.54				
Øb2	. 0325	. 0335	. 83	. 85				
•	. 1995	. 2005	5.07	5. 09				
e1	. 0995	. 1005	2.53	2.55				
h	. 150 N	ominal	3.81	Vomina				
1	. 0175	. 0180	. 44	.46	·			
11	. 0350	. 0355	. 89	. 90	•			
k	. 009	. 011	. 23	, 28				
k1	. 125 N	lominal	3.18	Kominal				
	. 372	. 378	9.45	9.60				
L ₁	. 054	. 055	1.37	1.40				
3	. 182	. 199	4.62	5, 05				
~	44.90	45. 10	44.90	45. 10				

NOTES:

- 1. The location of the tab locator within the limits indicated will be determined by the tab and flange dimensions of the device being checked.
- 2. The following gaging procedure shall be used:

The device being measured shall be inserted until its seating plane is .125(3.18 mm) \pm .010(.25 mm) from the seating surface of the gage. A force of 8 \pm .5 oz. shall then be applied parallel and symmetrical to the device's cylindrical axis. When examined visually after the force application (the force need not be removed) the seating plane of the device shall be seated against the gage.

The use of a pin straightener prior to insertion in the gage is permissible.

- Gaging plane.
 Drill angle.

FIGURE 2. Gage for lead and tab location for transistor types 2N328A and 2N329A.

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TABLE I. Group A inspection

	1	MIL-STD-750				imi ta	T
Examination or lest	Method	Dereils	LTPD	Symbol	Min	Men	Unit
Subgroup 1			10				
Visual and mechanical examination	2071						
Subgroup 2			5		-		
Collector to base cutoff current	3036	Bias cond. D; VCB = -50 Vdc		1CBO		-0.1	μAdc
Collector to emitter voltage (saturated) 2N328A	3071	Ig = -2 mAdc		V _{CE} (sat)		-0.3	Vdc
2N329A		IC = -15 mAde				-0.4	Vdc
Forward-current transfer ratio 2N328A	3076	VCE = -0.5 Vdc; IC = -3 mAdc		hFE	18	44	
2N329A			5		36	88	
Subgroup 3 Emitter to base cutoff	3061	Discount D	1	•			
current	3061	Bias cond. D; VEB = -30 Vdc		IEBO		05	μAdc
Collector to base cutoff current	3036	Bias cond. D; VCB = -30 Vdc		ICBO		03	μAdc
Breakdown voltage, collector to emitter 2N328A 2N329A	3011	Bias cond. D; IC = -50 μAdc		BVCEO	-40 -35		Vdc Vdc
Small-signal short-circuit forward-current transfer- ratio cutoff frequency	3301	V _{CB} = -5 Vdc I _E = 3 mAde		fhfb			
2N328A 2N329A					200 250		kHz kHz
Subgroup 4			5				
Base emitter voltage (assurated)	3066	Test cond. A; IC = -3 mAdc; IB = -1 mAdc		V _{BE} (sat)		-1.0	Vdc
Base emitter voltage (saturated)	3086	Test cond. A; IC = -10 mAdc; IB = -2 mAdc		VBE(sat)		-1.5	Vdc
Forward-current transfer ratio	3076	VCE = -1.5 Vde; IB = -1 mAdc		ple		•	
2N328A 2N329A					9 15	36 72	
*Open circuit output capacitance	3236	VCB = -6 Vdc; Ig = 0; 100 kHz ≤ f ≤ 1 MHz		Copo		110	pF

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TABLE L Group A inspection - Continued

	MIL-STD-750				Limits		
Exemination or test	Method	Deseils	LTPD	Symbol	Min	Mex	Unit
Subgroup 5			10				
High-temperature operation:		T _A = +125°C					
Collector to base cutoff current	3036	Bias cond. D; VCB = -30 Vdc		1CBO		-10	μ Adc
Low-temperature operation:		TA65°C					
Forward-current transfer ratio	3076	Vcz = -0.5 Vdc; IC = -3 mAdc		par			
2N328A 2N329A					9 18		

TABLE II. Group B inspection

		MIL_STD=750			اضا	mits	
Examination or 1951	Mathed	Details	LTPD	Symbol	Min	ii ea	Unit
Subgroup 1			20				
Physical dimensions	2066	See figure 1					
• Subgroup 2			15	.			
Solderability	2026						
Thermal shock (temperature cycling)	1051	Test cond. C					
Thermal shock (glass strain)	1056	Test condition A					
Hermetic seal	1071	Test cond. G or E for fine leaks; test cond. A, C, D, or F for gross leaks		•••		1×10-7	atm cc/s
Moisture resistance	1021	Omit initial conditioning					
End points:							
Collector to base cutoff current	3036	Bias cond. D; VCB = -30 Vdc		_I CBO		03	μ Adc
Forward-current transfer ratio 23328A 23329A	3076	VCE = -0.5 Vde; IC = -3 mAdc		ple	18 36	44 88	
Subgroup 3			15				
Shock	2016	Nonoperating; 1,500 G, for 0.5 ms, 5 blows in each orientation: X1, Y1, Y2, and Z1					

TABLE IL Group B inspection - Continued

		MIL-STD-750			L	mire.	
Exemination or 1961	Mothed	Donaila	LTPD	Symbol	Min	Mex	Unit
Subgroup 3 - Continued							
Vibration, variable frequency	2056	Nonoperating		***			
Constant acceleration	2006	20, 000 G; in each orienta- tion: X1, Y1, Y2, and Z1					
End points: (Same as subgroup 2)					•		
Subgroup 4			20				
Terminal strength (lead fatigue)	2036	Test condition E			•		
End points:							
Hermetic seal	1071	Test cond. G or H for fine leaks; test cond. A, C, D, or F for gross leaks				1×10-7	stm cc/s
Subgroup 5			20		Ì		
Salt atmosphere (corrosion)	1041						
Subgroup 6			10				
High-temperature life (nonoperating)	1032	T _{stg} = +200°C (see 4.3.4)					
End points:							
Collector to base cutoff	3036	Bias condition D; VCB = -30 Vdc		_I CBO		06	μAdc
Forward-current transfer ratio 2N328A 2N329A	3076	VCE = -0.5 Vdc; IC = -3 mAde		hFE	14 28	52 104	
Subgroup 7			10				
Steady-state operation life	1027	PT = 400 mW; VCB = -20 Vdc (see 4.3.4)					
End points: (Same as subgroup 6)							

TABLE III. Group C inspection

_		MIL-STD-730			نا	ei ta	
Exemination or test	Mothed	Dereils	LTPD	Symbol	Min	Mex	Unit
Subgroup 1			20				
Thermal resistance	3151			θJ-A		0.44	°C/mW

TABLE III. Group C inspection - Continued

	MIL_STD_750				انيا	erite	
Exemination or toat	Method	Deveils	LTPD	Symbol	Min	Mex	Unit
Subgroup 2 Resistance to solvents		MIL-STD-202, Method 215 (see 4.4.1)	10				
• Subgroup 3 High temperature life (nonoperating)	1031	T _{Stg} = +200°C (see 4.3.4)	λ = 10	***			
End points: (Same as subgroup 6 of group B) Subgroup 4			λ = 10				
Steady-state operation life	1026	Pr = 400 mW; VCB = -20 Vdc; (see 4.3.4)					
End points: (Same as subgroup 6 of group B)							

4. QUALITY ASSURANCE PROVISIONS

- 4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-6 19500, and as specified herein.
- 4.2 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in tables I, II, and III.
- 4.3 Quality conformance inspection. Quality conformance inspection shall consist of group A, B, and C inspections.
- 4.3.1 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table I.
- 4.3.2 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table Π .
- 4.3.3 Group C inspection. Group C inspection shall consist of the tests specified in table III. This inspection shall be conducted on the initial lot and thereafter every 6 months during production.
- 4.3.4 Group B and group C life-test samples. Samples that have been subjected to group B, 340-hour life-test, may be continued on test to 1,000 hours in order to satisfy group C life-test requirements. These samples shall be predesignated, and shall remain subjected to the group C 1,000-hour acceptance evaluation after they have passed the group B, 340-hour acceptance criteria. The cumulative total of failures found during 340-hour test and during the subsequent interval up to 1,000 hours shall be computed for 1,000-hour acceptance criteria, see 4.3.3.

- 4.4 Methods of examination and test. Methods of examination and test shall be as specified in tables I, II, and III, and as follows:
- 4.4.1 Resistance to solvents. Transistors shall be subjected to tests in accordance with method 215 of Mil.-STD-202. The following details shall apply:
 - (a) All areas of the transistor body where marking has been applied shall be brushed.
 - (b) After subjection to the tests, there shall be no evidence of mechanical damage to the device and markings shall have remained legible.
 - 5. PREPARATION FOR DELIVERY
 - 5.1 Preparation for delivery. Preparation for delivery shall be in accordance with MIL-S-19500.
 - 6. NOTES
 - 6.1 Notes. The notes specified in MIL-S-19500 are applicable to this specification.
- 6.2 Ordering data.
 - (a) Lead finish if other than gold-plated (see 3.3.1).
 - (b) Selectivity of lead material (see 3.3.1.1).
- 6.3 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes (additions, modification, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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Review activities: Army - MU, MI Air Force - 11, 80 DSA - ES

User activities:

Army - AV, SM Navy - AS, CG, MC, OS, SH Air Force - 13, 15, 19 Preparing activity: Army - EL

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(Project 5961-0305)

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